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Guest Editorial — Two Cultures and the Information Explosion

We live today in a dangerously unstable and incongruous world. As a travelling scientist in recent years I have dined with friends whose principal problems were calories and obesity and hurried through gloomy alleyways where starving children slept on the pavement for want of a better home or shelter. I have been plied with cocktails in foam-padded chairs at near the speed of sound over the Pacific Ocean and photographed foot-weary peasants, miles from their village, overburdened by their precious loads of firewood. All in a world whose population will double by the end of the century; and more than half the present population is undernourished, despite a level of science and technology which could probably solve the problem within a generation.

Has the scientist anything more to offer society than the extra miles per hour, the new antibiotic, the faster computer, or the hydrogen bomb? I feel that he has and he must, but he is handicapped by the weight of his own information explosion and by its effect upon his education and later professional outlook.

I suggest that in teaching and research we are developing science too much as a technical tool and tend to ignore its value as a guide to human thought and relationships. Before the scientist can play a more effective role in society, he must first put his own house in order. He must learn to contain and handle his own information explosion. Surely it is this explosive growth in scientific and technical

knowledge which is the really unique phenomenon in the history of human society. There is abundant evidence that the population explosion is one consequence of the information explosion, although perhaps indirectly as a result of an unbalanced application of the resulting technology.

C. P. Snow identified the information explosion with the barrier of communication between the scientist and humanist; the gulf between the two cultures. In his erudite monograph Foskett (1) has examined the increasing lack of communication between the scientist and humanist from the point of view of the professional librarian: One faced with the task of trying to maintain information retrieval in a world whose boundaries, like those of the expanding universe, are lost forever to the observer's telescope. He comes to the conclusion that "Scientists tend to assume airs of arrogant superiority over non-scientists...control over material phenomena is possible to an extent undreamt of even fifty years ago, and rightly used, the discoveries of science could bring about that revolution in our material conditions foreseen by Wordsworth, who put the poet at the side of the man of science ..... There is no hope of such a creative partnership while scientists fail to carry out their duty of making these discoveries familiar". If the scientist does give this impression of himself it is a reflection of his education; a result of not seeing his fellow men and his environment in the very perspectives dictated by the world of science. This, in turn, is because we are educating technicians rather than scientists. We lose sight of the wood too easily for the technical trees.

Are not university courses terribly cluttered with unnecessary or even obsolete technical knowledge? Are we not attempting the impossible by trying to contain forever an exploding volume of knowledge? I suggest that the problems of documentation and information retrieval must play a much more vital role in scientific education. This would facilitate elimination from the syllabus of certain knowledge once documented and rapidly available through efficient information retrieval. It would give more scope for original thought; a chance to examine some of the fundamental problems of our time.

Let us adjust our perspectives. Geologists tell us that the earth is of the order of five billion years old. In order to grasp this time scale let us suppose that the earth was formed on the occasion of the birth of Jesus Christ, 2,000 years ago. Now on this scale William Caxton printed his first book just under three hours ago. The Wright brothers made their first powered flight ten minutes ago and 90% of all the world's scientists have been born since! The world population also doubled in the last ten minutes. We exploded the first atomic bomb less than two minutes ago. On this time scale the growth of scientific information and technology can indeed be seen as an explosion. It is an especially sobering thought if we try to look forward, just ten minutes!

Now let's turn our attention to space. Hoyle (2) considers it probable that there are one hundred thousand million stars with

planetary systems in our Milky Way galaxy alone. Hence "The probability of there being intelligent life 'out there' is overwhelmingly high". Hoyle has seriously suggested that with radiotelescopes little more sophisticated than those already in existence we should be able to establish a range of communication to embrace the nearest million stars. Somewhere in the million, Hoyle suspects, there are planets on which has evolved intelligence comparable or superior to our own. He has speculated that intelligent radio-communication may have been in progress for millions of years. If indeed we can tap such a cosmic reservoir of intelligence, get into the galactic telephone directory as Hoyle puts it, then our own information explosion becomes a mere bubble.

Is it easy for the scientist to conjure up feelings of superiority or arrogance with this picture of his environment? Certainly not if this sort of cosmological appreciation were part of his education. In this way he could better approach the larger problems of humanity with essential humility. The humility due to the constant knowledge of our colossal relative ignorance.

What do we ask when trying to assess a candidate for appointment or promotion? "How many papers has he published?" Perhaps we scan the titles or read a few summaries, lest we appoint a geneticist instead of a taxonomist! How often do we read even one of his papers from beginning to end? Not frequently. We haven't time. So the young scientist with an eye to attracting the attention of his peers gets out as many papers as he can.

We are all familiar with the appearance of substantially the same article in two or more journals. And there is another form of duplication: how many times do we read an almost identical description of some well established experimental procedure such as this:- twenty grams of tissue were representatively sampled and accurately weighed into a Soxhlet extraction thimble and extracted for 24 hours with A. R. benzene. The extract was taken to dryness on a water bath and the non-volatile residue weighed etc. etc.

Before publishing we should first ask if we will contribute either to the knowledge which the student should embrace or to that to which the specialist should have access. If the answer be no then we should abstain even though it would give us our century. If yes, then how can we strip the publication of non-essentials? Is it to be a work of literature or a scientific communication? Surely the latter. One way of improving scientific communication would be to devise a kind of international shorthand. Some abstracting services have started this but we could go a good deal further so that the Soxhlet extraction paragraph might read something like: - Weight non-vol 24hr. C_6H_6 extr. 20 g tissue. Many consecutive operations such as those involving extraction, fractionation, detection and assay might well be indicated by a symbolic flow sheet. An International Conference to formulate such a shorthand based on English would be a most valuable contribution. Once terms and expressions were agreed upon, they could be published by the various learned societies in their Journals and their use insisted upon as indeed many abbrev-

iations already are. What I'm suggesting is that it's high time we regarded routine scientific publication for what it is: communication and documentation; not a work of literature.

Society is becoming increasingly dependent upon science and technology in a world of limited resources and dangerously unstable international relationships. This is clearly appreciated by politicians and administrators but the present tendency is merely to impose administrative or political philosophies on the world of science. The converse would be more to the point. That is, the philosophy of science, an absolute respect for the truth, might be profitably applied to the problems of government and administration and even, perhaps, to commercial advertising.

International instability has become a universal threat. These problems are a direct result of the impact of science on society. They require scientific analysis and control in a spirit of scientific humanism. Meanwhile, the best we can hope for is to keep open the communications between the nations. The machinery for this exists through the United Nations and its scientific or specialist agencies. The scientists of the world speak a common language and must subscribe to the same respect for universal truths. They have the best opportunities for international meetings and social and professional intercourse.

They must learn to contain their information explosion; to re-examine urgently the whole structure of scientific publication. Only then will they have the time to regain sight of the wood for the trees. The education of every scientist should provide for an objective scientific appreciation of his human and physical environment and the impact of his own technology. He will then be in a position to regulate better the production of "dangerous knowledge and disorganization" and to challenge its political abuse.

Unless every scientist emerges from the swamp of his own information he may indeed find himself continually on tap but never on top: an increasingly dangerous world will remain the politician's toy!

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(2) Hoyle. F. Saturday Review, 1964.